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# Information technology — Trusted Platform Module Library —

## Part 1: Architecture

*Technologies de l'information — Bibliothèque de module  
de plate-forme de confiance —*

*Partie 1: Architecture*

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## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: [Foreword — Supplementary information](#).

ISO/IEC 11889-1 was prepared by the Trusted Computing Group (TCG) and was adopted, under the PAS procedure, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

This second edition cancels and replaces the first edition (ISO/IEC 11889-1:2009), which has been technically revised.

ISO/IEC 11889 consists of the following parts, under the general title *Information technology — Trusted Platform Module Library*:

- *Part 1: Architecture*
- *Part 2: Structures*
- *Part 3: Commands*
- *Part 4: Supporting routines*

## Introduction

Collectively the four parts of ISO/IEC 11889 specify the architecture, data structures, command interface and behavior of a Trusted Platform Module (TPM). A properly constructed platform that incorporates a TPM meeting the requirements may enable establishing trust in platform scenarios involving security and privacy.

TPMs require hardware protections to provide three roots of trust: storage, measurement, and reporting. Basing TPM roots of trust in hardware is an improvement over software based solutions whose protections are vulnerable to malicious software. The architecture defines a TPM that is a passive component that receives commands and returns responses. The commands defined have meticulous descriptions and perform primitive actions on data confidential to the TPM. Typical implementations integrate a TPM in the context of a platform like a laptop or a mobile device. By sending commands to a TPM and processing the responses, security benefits accrue for the platform as a whole. Properly constructed platforms with a TPM can provide hardware based roots of trust for storage, measurement and/or reporting.

The root of trust for storage consists primarily of creating, managing and protecting cryptographic keys and other data values. Artifacts protected by or associated with encryption keys, like passwords, certificates or other credentials, can be used for authentication and many other security scenarios. Cryptographic keys can be created with restrictions on their use or management.

**EXAMPLE 1** Cryptographic keys can be created that require a password to be used, have a single purpose (e.g. signing), or cannot be exported elsewhere.

Separate from cryptographic key management, the root of trust for storage also allows data values to be stored in a TPM so they are protected from unauthorized modification or can only be changed in defined ways.

**EXAMPLE 2** A data value protected by the TPM might be defined so it can be incremented but not decremented.

Typical use cases can include storing security policy information that can only be updated by an authorized entity or incrementing a value to keep track of failed password entry attempts.

The root of trust for measurement is intended to reflect what software is running on a platform in a trusted way. This root consists of the TPM and other components of a platform that start a chain of measurements. Before software runs, its measurement is calculated and stored in the TPM by sending a command. Later software can add more measurements, but cannot erase its own measurement that was recorded before it started running. If the measurement process unconditionally starts when a platform is powered on, the TPM ends up holding an accurate measurement of all the software running on the system from each power-on. Across power cycles, the same software running on a platform results in the same measurements being present in the TPM. Combining the root of trust for measurement with the root of trust for storage, it is possible to create keys or store data using the TPM that only software with specific measurements can use. The result is specific software on a platform can maintain its own keys, confidential data or security policy information that is not accessible and not able to be tampered with by other software that may run on the platform.

The root of trust for reporting helps entities external to a platform establish trust in platform software measurements or cryptographic keys by proving the values exist in a TPM. TPMs have Endorsement Keys that are essentially unique identities for a TPM. Through commands the TPM provides, it is possible to prove keys exist in a TPM with a specific Endorsement Key. Establishing that a key exists in a TPM permits services external to the TPM to trust a key is protected by a TPM's root of trust for storage. Also, if a key is known to be in a TPM, and the key is used to sign measurements of software, evidence of what software is running on a platform can be shared with an external entity in a trusted way. This enhances privacy protections as the need to share the TPM's Endorsement Key identity directly with a remote verifier can be avoided, resulting in a platform that can anonymously prove to a remote verifier what software is running.

Not all privacy and security use cases enabled by this International Standard are relevant for all platforms. For this reason, this International Standard is defined as a generic library of commands, cryptographic algorithms and capabilities for which a subset can be used to meet the needs of a specific



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platform or implementation, with the flexibility to meet diverse and even contradictory global requirement sets. To address the needs of platform types, market segments, regulations, assurance criteria, certification programs, etc., the structure allows complimentary materials to be developed by interested parties constraining the generic library to address specific requirement sets. To promote product interoperability, implementers are encouraged to consult existing specifications augmenting this International Standard with domain specific considerations for specific applications and platform types. A platform specific context is able to articulate scenarios, functionality, relevant security and privacy goals, implementation considerations and methods of assurance. Because of the generic nature of this International Standard, certification programs are likely to be based on additional specifications that further define platform specific implementations and security characteristics. Having a single TPM library that implementations across different platforms types can use to add security and privacy benefits lowers complexity and permits reuse of software and security analysis across the trusted computing ecosystem.

**EXAMPLE 3** Opt-in versus secure by default are examples of contradictory requirements for TPM provisioning that are both supported by this International Standard.

This International Standard is useful for a variety of audiences. Two key audiences are TPM implementers and adopters. Clauses 6 and 7 in this part of ISO/IEC 11889 are useful to orientate audiences to the organization of the four parts and how they are used to build a compliant implementation. Implementers will need to use all four parts to build a compliant implementation. Adopters can benefit from the architectural concepts in this part of ISO/IEC 11889 when developing scenarios and incorporating a TPM into a platform design. ISO/IEC 11889-2 and ISO/IEC 11889-3 are beneficial for adopters to understand the syntax and semantics of using individual TPM commands.

Implementers and adopters of this International Standard need to carefully assess the appropriateness of controllability, security and privacy capabilities and algorithms implemented for satisfying their goals. In assessing algorithms, implementers and adopters should diligently evaluate available information. Solutions involving cryptography are dependent on the solution architecture and on the properties of cryptographic algorithms supported. Over time, cryptographic algorithms can develop deficiencies for reasons like advances in cryptographic techniques or increased computing power. Solutions that support a diversity of algorithms can remain durable when subsets of supported algorithms wane in usefulness. Therefore, implementers intent on providing robust solutions are responsible for evaluating both algorithm appropriateness and diversity.

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# Information technology — Trusted Platform Module Library —

## Part 1: Architecture

### 1 Scope

This part of ISO/IEC 11889 defines the architectural elements of the Trusted Platform Module (TPM), a device which enables trust in computing platforms in general. Some TPM concepts are explained adequately in the context of the TPM itself. Other TPM concepts are explained in the context of how a TPM helps establish trust in a computing platform. When describing how a TPM helps establish trust in a computing platform, this part of ISO/IEC 11889 provides some guidance for platform requirements. However, the scope of ISO/IEC 11889 is limited to TPM requirements.

This part of ISO/IEC 11889 illustrates TPM security and privacy techniques in the context of a platform through the use of cryptography. It includes definitions of how different cryptographic techniques are implemented by a TPM. The scope of ISO/IEC 11889 does not include cryptographic analysis or guidance about the applicability of different algorithms for specific uses cases.

TPM requirements in this part of ISO/IEC 11889 are general, covering concepts like integrity protection, isolation and confidentiality. Defining a specific strength of function or assurance level is out of scope for ISO/IEC 11889. This approach limits the guarantees provided by ISO/IEC 11889 itself, but it does allow the TPM architectural elements defined to be adapted to meet diverse implementation and platform specific needs.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- ISO/IEC 9797-2, *Information technology -- Security techniques -- Message Authentication Codes (MACs) -- Part 2: Mechanisms using a dedicated hash-function*
- ISO/IEC 10116:2006, *Information technology — Security techniques — Modes of operation for an n-bit block cipher*
- ISO/IEC 11889-2, *Information technology — Trusted Platform Module Library — Part 2: Structures*
- ISO/IEC 11889-3, *Information technology — Trusted Platform Module Library — Part 3: Commands*
- ISO/IEC 11889-4, *Information technology — Trusted Platform Module Library — Part 4: Supporting routines*
- TCG Algorithm Registry, available at  
<[http://www.trustedcomputinggroup.org/resources/tcg\\_algorithm\\_registry](http://www.trustedcomputinggroup.org/resources/tcg_algorithm_registry)>